Volunteer Lake Assessment Program Individual Lake Reports

WARREN LAKE, ALSTEAD, NH

MORPHOMETRIC DATA

Watershed Area (Ac.):	3,237	**Max. Depth (m):**	4.2	**Flushing Rate (yr^{-1})**	4.2
Surface Area (Ac.):	185	**Mean Depth (m):**	2	**P Retention Coef:**	0.57
Shore Length (m):	5,500	**Volume (m^3):**	1,503,500	**Elevation (ft):**	1200

TROPHIC CLASSIFICATION

Year	Trophic class
1991	OLIGOTROPHIC
2005	MESOTROPHIC

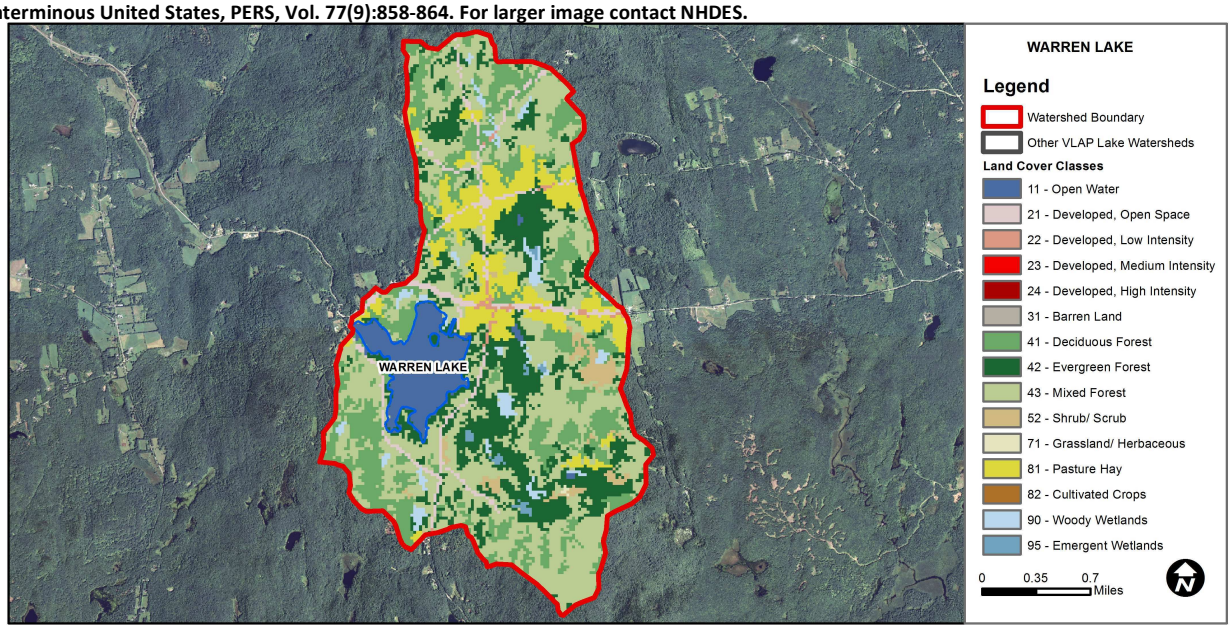
KNOWN EXOTIC SPECIES

The Waterbody Report Card tables are generated from the DRAFT 2014 305(b) report on the status of N.H. waters, and are based on data collected from 2004-2013. Detailed waterbody assessment and report card information can be found at www.des.nh.gov/organizations/divisions/water/wmb/swqa/index.htm

Designated Use	Parameter	Category	Comments
Aquatic Life	Phosphorus (Total)	Slightly Bad	The calculated median is from 5 or more samples and is > indicator and the chlorophyll a indicator is exceeded.
	pH	Bad	>10%, with a minimum of 2, samples exceed criteria, with 1 or more by a large margin.
	Oxygen, Dissolved	Encouraging	There are < 10 samples with 0 exceedances of criteria. More data needed.
	Dissolved oxygen satura	Encouraging	There are < 10 samples with 0 exceedances of criteria. More data needed.
	Chlorophyll-a	Slightly Bad	The calculated median is from 5 or more samples and is > indicator.
Primary Contact Recreation	Escherichia coli	Very Good	Where there are no geometric means, all bacteria samples are < 75% of the geometric mean. Where there are geometric means all single bacteria samples are < the SSMC and all geometric means are < geometric mean criteria.
	Chlorophyll-a	Very Good	There are a total of at least 10 samples with 0 exceedances of indicator.

WATERSHED LAND USE SUMMARY

Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, J., 2011. Completion of the 2006 National Land Cover Database for the Conterminous United States, PERS, Vol. 77(9):858-864. For larger image contact NHDES.



Land Cover Category	% Cover	Land Cover Category	% Cover	Land Cover Category	% Cover
Open Water	6.52	Barren Land	0	Grassland/Herbaceous	0.04
Developed-Open Space	3.66	Deciduous Forest	19.12	Pasture Hay	10.13
Developed-Low Intensity	0.58	Evergreen Forest	19.45	Cultivated Crops	0
Developed-Medium Intensity	0	Mixed Forest	35.78	Woody Wetlands	2.31
Developed-High Intensity	0	Shrub-Scrub	1.88	Emergent Wetlands	0.44

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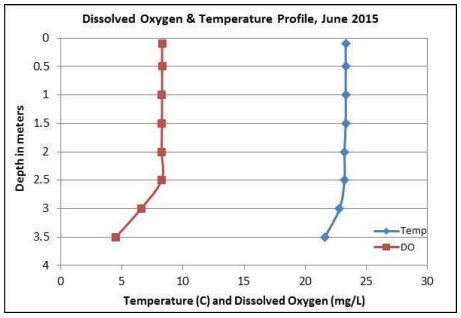
Warren Lake, Alstead

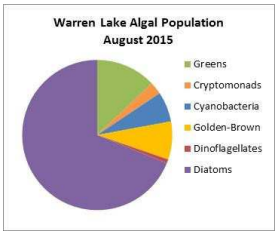
2015 Data Summary

Recommended Actions: The increasing epilimnetic phosphorus levels and elevated chlorophyll levels since 2013 are concerning. This has also caused a significant decline in transparency. The increased frequency and intensity of storm events combined with low water levels could transport and concentrate nutrients necessary for algal growth. Storm events could also transport sediment, and the already shallow depth of the pond, combined with low water levels and boating traffic could churn up bottom sediments that can contribute to elevated nutrient levels, algal growth and decreased lake transparency. It is important to educate lake users on good boating practices to minimize impacts to the lake bottom. The new DES fact sheet "Impacts of Motorized Craft on N.H.'s Waterbodies" is a great resource. Spruce River contributes the largest amount of chloride and efforts should be made to try and reduce chloride levels in the river. Keep up the great work!

Observations (*Refer to Table 1 and Historical Deep Spot Data Graphics)*

- **Chlorophyll-a:** Chlorophyll levels were elevated in June and indicative of a spring Diatom bloom. Chlorophyll levels decreased slightly in July and August but remained elevated and greater than the state median. Historical trend analysis indicates relatively stable chlorophyll levels with moderate variability between years.
- **Conductivity/Chloride:** Deep spot conductivity and chloride levels were slightly greater than the state median but not above a level of concern. Historical trend analysis indicates relatively stable epilimnetic (upper water layer) conductivity since monitoring began. Colburn Hill Bk., Dam Bk., Pickerel Cove Bk., and Smith Hill Bk. conductivity levels ranged from slightly elevated to low and chloride levels indicate these are likely natural fluctuations and not impacted by road salt. Carmen Cove Bk. conductivity and chloride were slightly greater than the state medians. Spruce River conductivity and chloride levels were slightly elevated and potentially impacted by road salting.
- **E. coli:** Boat landing and Edith's Beach E. coli levels were low and less than the state standard of 88 cts/100 mL for public beaches.
- **Total Phosphorus:** Epilimnetic phosphorus levels were slightly elevated in June and July which likely contributed to the elevated algal growth. Average epilimnetic phosphorus levels increased from 2014 and were greater than the state median. Historical trend analysis indicates significantly increasing (worsening) epilimnetic phosphorus since monitoring began. Colburn Hill Bk., Dam Bk. and Smith Hill Bk. phosphorus levels were within low to average ranges. Carmen Cove and Pickerel Cove Bk. phosphorus levels were elevated in June following a significant storm event and combined with low flow conditions. Spruce River phosphorus levels were elevated on each sampling event, particularly in June.
- **Transparency:** Transparency (NVS) decreased (worsened) from June to July and then increased (improved) from July to August. Average transparency was stable with 2014 and much less than the state median. Historical trend analysis indicates significantly decreasing (worsening) transparency since monitoring began. Transparency measured with the viewscope (VS) was generally slightly better than without and likely a better representation of conditions.
- **Turbidity:** Epilimnetic turbidity was slightly elevated on each sampling event likely due to the elevated algal growth. Carmen Cove and Colburn Hill Bk. turbidities were relatively low on each sampling event. Dam Bk., Pickerel Cove Bk., and Spruce River turbidities were elevated in June following a significant storm event. Smith Hill Bk. turbidity was slightly elevated in June and August following significant storm events.
- **pH:** Epilimnetic pH fluctuated below the desirable range 6.5-8.0 units in July but average epilimnetic pH was within the desirable range. Historical trend analysis indicates relatively stable epilimnetic pH with moderate variability between years. Tributary pH levels were generally within the desirable range except for Smith Hill Bk. pH which was slightly acidic.





NH Water Quality Standards: Numeric criteria for specific parameters. Results exceeding criteria are considered a water quality violation.
Chloride: > 230 mg/L (chronic)
E. coli: > 88 cts/100 mL – public beach
E. coli: > 406 cts/100 mL – surface waters
Turbidity: > 10 NTU above natural level
pH: between 6.5-8.0 (unless naturally occurring)

Table 1. 2015 Average Water Quality Data for WARREN LAKE

Station Name	Alk. mg/l	Chlor-a ug/l	Chloride mg/l	Cond. uS/cm	E. Coli #/100ml	Total P ug/l	Trans. m		Turb. ntu	pH
							NVS	VS		
Epilimnion	5.6	8.08	12	69.4		14	1.94	2.44	2.07	6.56
Hypolimnion				57.5		14			2.44	6.37
Boat Landing					27					
Carmen Cove Brook			20	110.6		16			0.83	6.54
Colburn Hill Brook			5	113.1		9			0.76	6.65
Dam Brook			4	78.5		12			3.83	7.00
Edith's Beach					17					
Pickerel Cove Brook			7	53.9		23			0.98	6.52
Smith Hill Brook			3	25.5		16			2.10	6.05
Spruce River			58	166.4		34			2.30	6.50

NH Median Values: Median values for specific parameters generated from historic lake monitoring data.
Alkalinity: 4.9 mg/L
Chlorophyll-a: 4.58 mg/m^3
Conductivity: 40.0 uS/cm
Chloride: 4 mg/L
Total Phosphorus: 12 ug/L
Transparency: 3.2 m
pH: 6.6

Historical Water Quality Trend Analysis

Parameter	Trend	Explanation	Parameter	Trend	Explanation
Conductivity	Stable	Trend not significant; data moderately variable.	Chlorophyll-a	Stable	Trend not significant; data moderately variable.
pH (epilimnion)	Stable	Trend not significant; data moderately variable.	Transparency	Worsening	Data significantly decreasing.
			Phosphorus (epilimnion)	Worsening	Data significantly increasing.